

## Lonten N-channel 40V, 120A, 2.9mΩ Power MOSFET

|   |  |           |     |                               |       |       |      |
|---|--|-----------|-----|-------------------------------|-------|-------|------|
| <p><b>Description</b><br/>                 These N-Channel enhancement mode power field effect transistors are using split gate trench DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and with stand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.</p> <p><b>Features</b></p> <ul style="list-style-type: none"> <li>◆ 40V, 120A, <math>R_{DS(on),max} = 2.9m\Omega @ V_{GS} = 10V</math></li> <li>◆ Improved dv/dt capability</li> <li>◆ Fast switching</li> <li>◆ 100% EAS Guaranteed</li> <li>◆ Green device available</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>◆ Motor Drives</li> <li>◆ UPS</li> <li>◆ DC-DC Converter</li> </ul> | <p><b>Product Summary</b></p> <table style="width: 100%; border: none;"> <tr> <td style="padding: 2px;"><math>V_{DSS}</math></td> <td style="padding: 2px;">40V</td> </tr> <tr> <td style="padding: 2px;"><math>R_{DS(on),max} @ V_{GS}=10V</math></td> <td style="padding: 2px;">2.9mΩ</td> </tr> <tr> <td style="padding: 2px;"><math>I_D</math></td> <td style="padding: 2px;">120A</td> </tr> </table> <p><b>Pin Configuration</b></p> <div style="text-align: center;"> <p style="font-size: small;">TO-220    TO-252    TO-251    DFN5x6</p> </div> <div style="text-align: right; margin-top: 20px;"> <p style="text-align: center;">N-Channel MOSFET </p> </div> | $V_{DSS}$ | 40V | $R_{DS(on),max} @ V_{GS}=10V$ | 2.9mΩ | $I_D$ | 120A |
| $V_{DSS}$   | 40V  |           |     |                               |       |       |      |
| $R_{DS(on),max} @ V_{GS}=10V$   | 2.9mΩ  |           |     |                               |       |       |      |
| $I_D$   | 120A   |           |     |                               |       |       |      |

### Absolute Maximum Ratings $T_C = 25^\circ C$ unless otherwise noted

| Parameter   | Symbol    | Value       | Unit |
|---|-----------|-------------|------|
| Drain-Source Voltage  | $V_{DSS}$ | 40          | V    |
| Continuous drain current ( $T_C = 25^\circ C$ ) <sup>1)</sup> | $I_D$     | 120         | A    |
| Continuous drain current ( $T_C = 100^\circ C$ )              |           | 76          | A    |
| Pulsed drain current <sup>2)</sup>                            | $I_{DM}$  | 360         | A    |
| Gate-Source voltage   | $V_{GSS}$ | ±20         | V    |
| Avalanche energy <sup>3)</sup>                                | $E_{AS}$  | 256         | mJ   |
| Power Dissipation ( $T_C = 25^\circ C$ )                      | $P_D$     | 62.6        | W    |
| Storage Temperature Range                                     | $T_{STG}$ | -55 to +150 | °C   |
| Operating Junction Temperature Range                          | $T_J$     | -55 to +150 | °C   |

### Thermal Characteristics

| Parameter                            | Symbol          | Value | Unit |
|--------------------------------------|-----------------|-------|------|
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 2.0   | °C/W |

**Package Marking and Ordering Information**

| Device     | Device Package | Marking    |
|------------|----------------|------------|
| LSGC04R029 | TO-220         | LSGC04R029 |
| LSGG04R029 | TO-252         | LSGG04R029 |
| LSGH04R029 | TO-251         | LSGH04R029 |
| LSGN04R029 | DFN5×6         | LSGN04R029 |

**Electrical Characteristics**
 $T_J = 25^\circ\text{C}$  unless otherwise noted

| Parameter   | Symbol       | Test Condition  | Min. | Typ. | Max. | Unit          |
|---|--------------|---|------|------|------|---------------|
| <b>Static characteristics</b>                                 |              |   |      |      |      |               |
| Drain-source breakdown voltage                                | $BV_{DSS}$   | $V_{GS}=0\text{ V}, I_D=250\mu\text{A}$   | 40   | ---  | ---  | V             |
| Gate threshold voltage  | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu\text{A}$   | 1.0  | 1.5  | 2.2  | V             |
| Drain-source leakage current                                  | $I_{DSS}$    | $V_{DS}=40\text{ V}, V_{GS}=0\text{ V}, T_J = 25^\circ\text{C}$                 | ---  | ---  | 1    | $\mu\text{A}$ |
| Gate leakage current, Forward                                 | $I_{GSSF}$   | $V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$   | ---  | ---  | 100  | nA            |
| Gate leakage current, Reverse                                 | $I_{GSSR}$   | $V_{GS}=-20\text{ V}, V_{DS}=0\text{ V}$  | ---  | ---  | -100 | nA            |
| Drain-source on-state resistance                              | $R_{DS(on)}$ | $V_{GS}=10\text{ V}, I_D=20\text{ A}$   | ---  | 2.5  | 2.9  | m $\Omega$    |
|   |              | $V_{GS}=4.5\text{ V}, I_D=20\text{ A}$  | ---  | 3.3  | 4.5  | m $\Omega$    |
| Forward transconductance                                      | $g_{fs}$     | $V_{DS}=5\text{ V}, I_D=20\text{ A}$  | ---  | 90   | ---  | S             |
| <b>Dynamic characteristics</b>                                |              |   |      |      |      |               |
| Input capacitance   | $C_{iss}$    | $V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V},$<br>$F = 1\text{ MHz}$              | ---  | 2718 | ---  | pF            |
| Output capacitance  | $C_{oss}$    |   | ---  | 1130 | ---  |               |
| Reverse transfer capacitance                                  | $C_{rss}$    |   | ---  | 85   | ---  |               |
| Turn-on delay time  | $t_{d(on)}$  | $V_{DD} = 20\text{ V}, V_{GS}=10\text{ V}, I_D = 20\text{ A}$<br>$R_G=10\Omega$ | ---  | 20.5 | ---  | ns            |
| Rise time   | $t_r$        |   | ---  | 22.5 | ---  |               |
| Turn-off delay time   | $t_{d(off)}$ |   | ---  | 110  | ---  |               |
| Fall time   | $t_f$        |   | ---  | 40   | ---  |               |
| <b>Gate charge characteristics</b>                            |              |   |      |      |      |               |
| Gate to source charge   | $Q_{gs}$     | $V_{DS}=20\text{ V}, I_D=20\text{ A},$<br>$V_{GS}=10\text{ V}$                  | ---  | 8.1  | ---  | nC            |
| Gate to drain charge  | $Q_{gd}$     |   | ---  | 6.2  | ---  |               |
| Gate charge total   | $Q_g$        |   | ---  | 42.5 | ---  |               |
| <b>Drain-Source diode characteristics and Maximum Ratings</b> |              |   |      |      |      |               |
| Continuous Source Current                                     | $I_S$        |   | ---  | ---  | 120  | A             |
| Pulsed Source Current <sup>4)</sup>                           | $I_{SM}$     |   | ---  | ---  | 360  | A             |
| Diode Forward Voltage   | $V_{SD}$     | $V_{GS}=0\text{ V}, I_S=20\text{ A}, T_J=25^\circ\text{C}$                      | ---  | 0.8  | 1.2  | V             |
| Reverse Recovery Time   | $t_{rr}$     | $I_S=I_F, di/dt=100\text{ A}/\mu\text{s}, T_J=25^\circ\text{C}$ <sup>5)</sup>   | ---  | ---  | 72   | ns            |
| Reverse Recovery Charge                                       | $Q_{rr}$     |   | ---  | ---  | 67   | nC            |

**Notes:**

- 1: The maximum junction current rating is package limited.
- 2: Repetitive Rating: Pulse width limited by maximum junction temperature.
- 3:  $V_{DD}=20\text{ V}, V_{GS}=10\text{ V}, L=0.5\text{ mH}, I_{AS}=32\text{ A}, R_G=25\Omega$ , Starting  $T_J=25^\circ\text{C}$ .
- 4: Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
- 5: Guaranteed by design, not subject to production.

**Electrical Characteristics Diagrams**

Fig 1: Output Characteristics

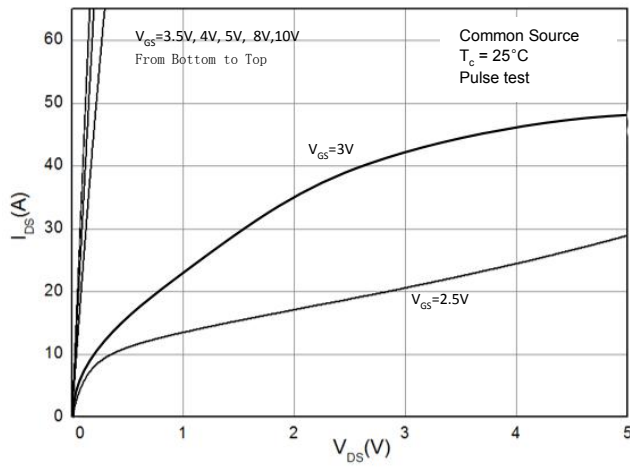


Fig 2: Transfer Characteristics

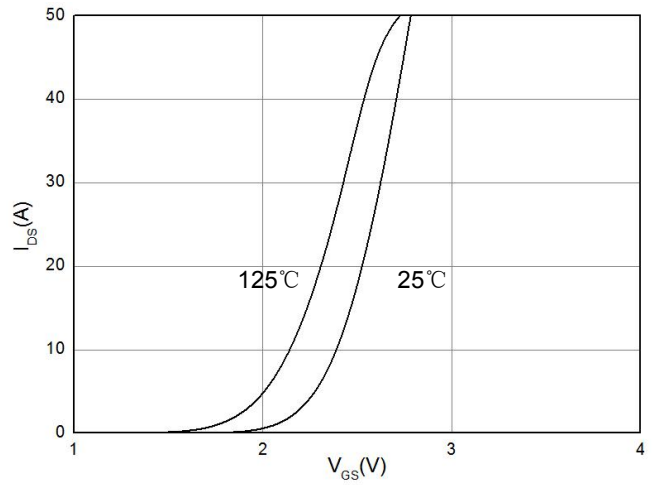


Figure 3. Capacitance Characteristics

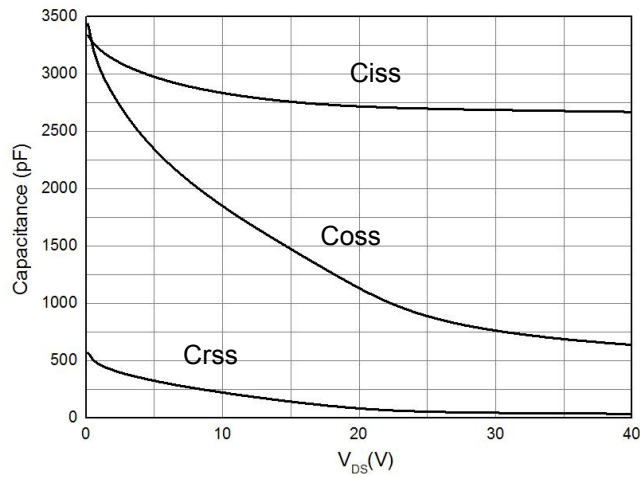


Figure 4. Gate Charge Waveform

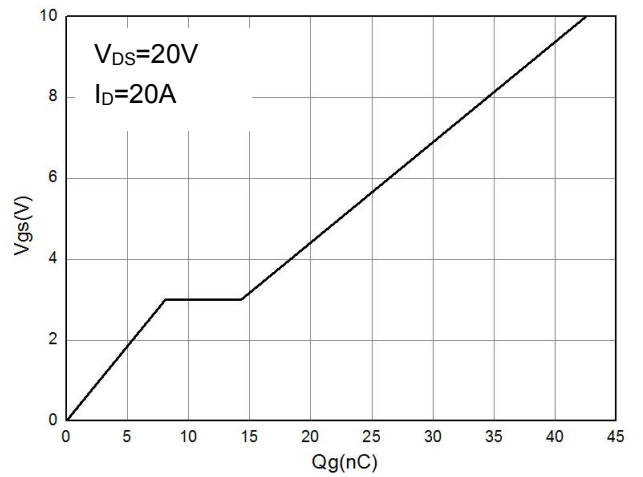


Figure 5. Body-Diode Characteristics

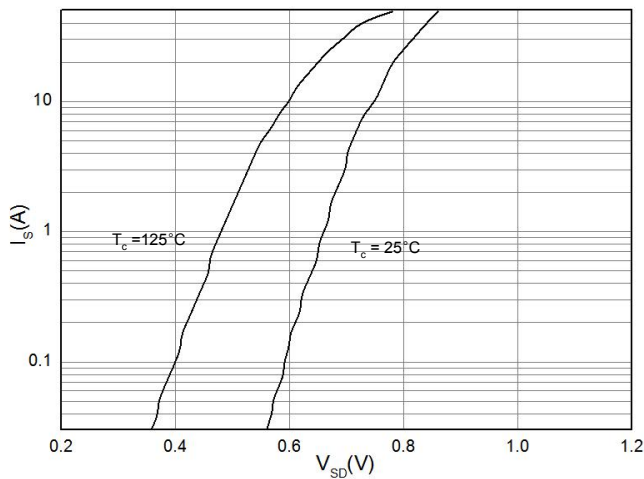


Figure 6. Rds(on)-Drain Current

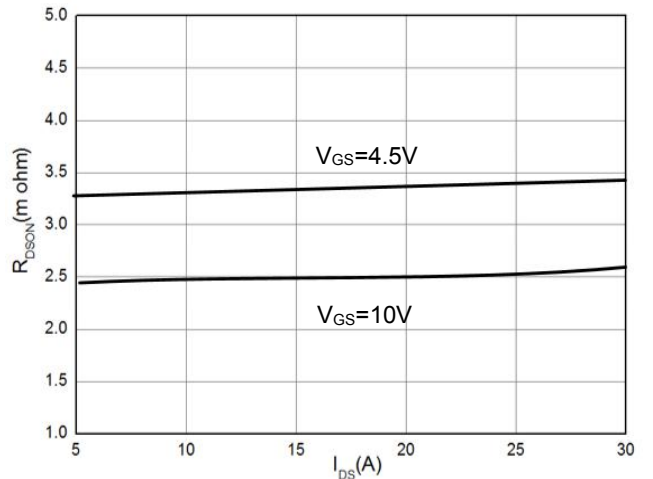


Fig 7: Rds(on) vs Gate Voltage

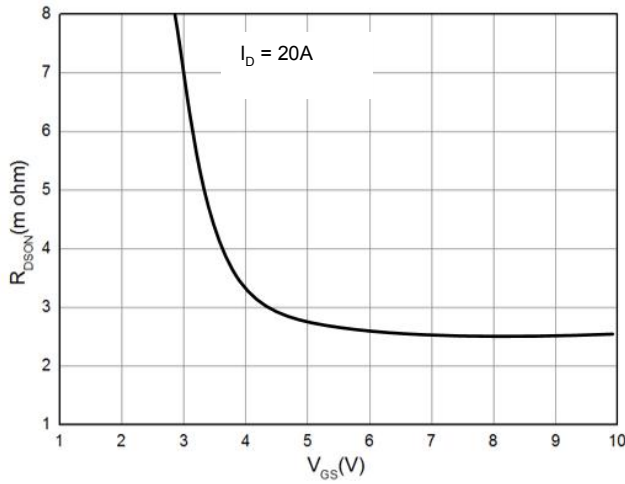


Fig 8: Rds(on)-Junction Temperature(°C)

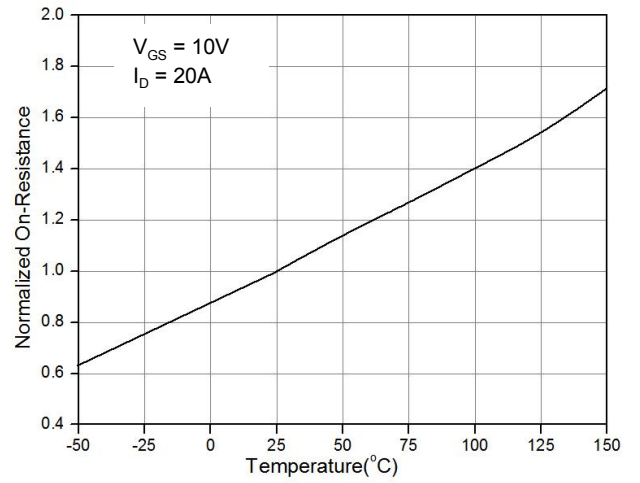


Figure 9. BVdss vs. Junction temperature

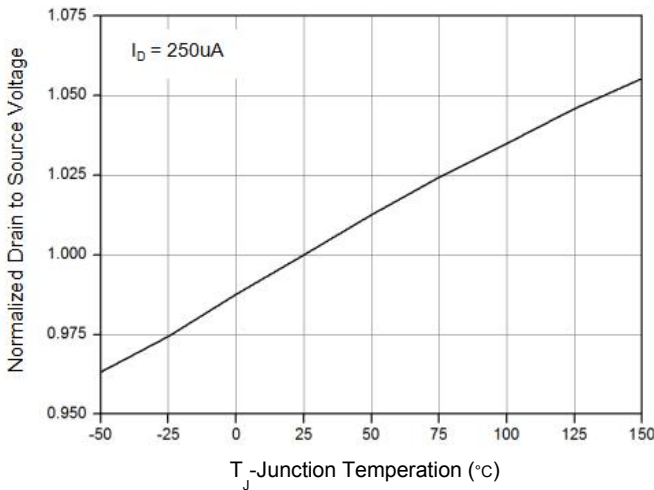


Figure 10. Maximum Safe Operating Area

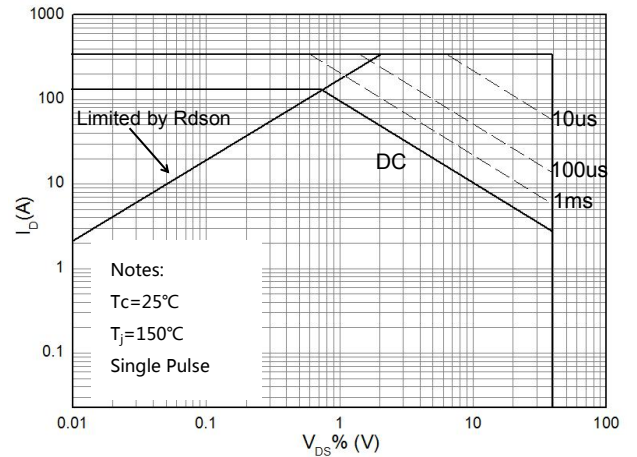
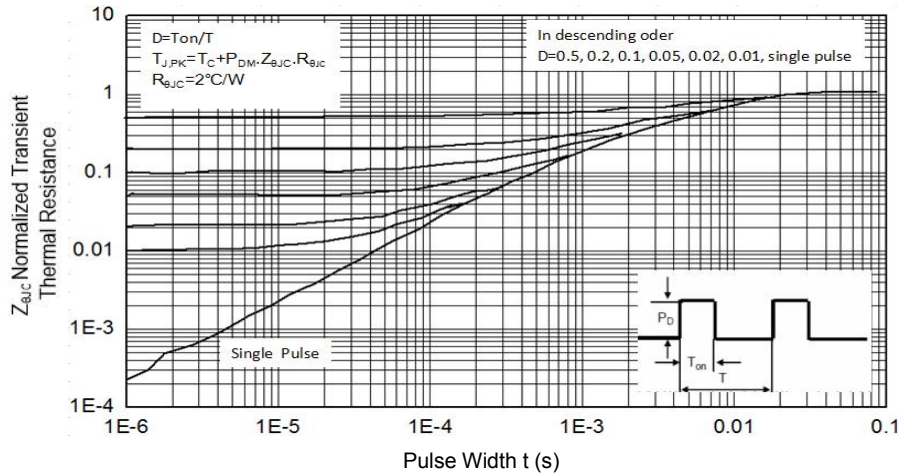


Figure 11. Normalized Maximum Transient Thermal Impedance (RthJC)



## Test Circuit & Waveform

Figure 12. Gate Charge Test Circuit & Waveform

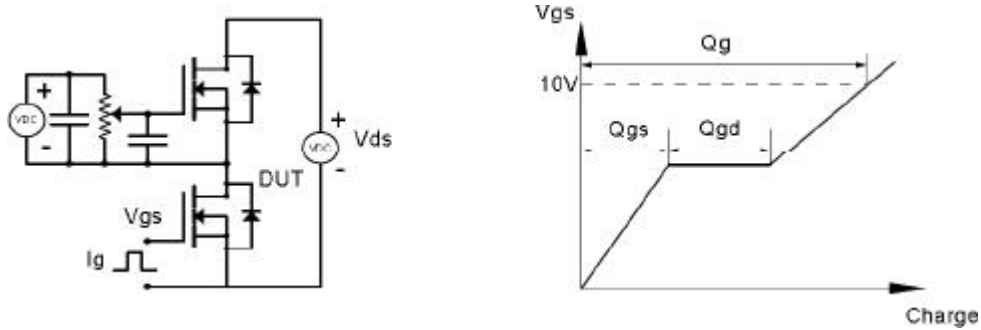


Figure 13. Resistive Switching Test Circuit & Waveforms

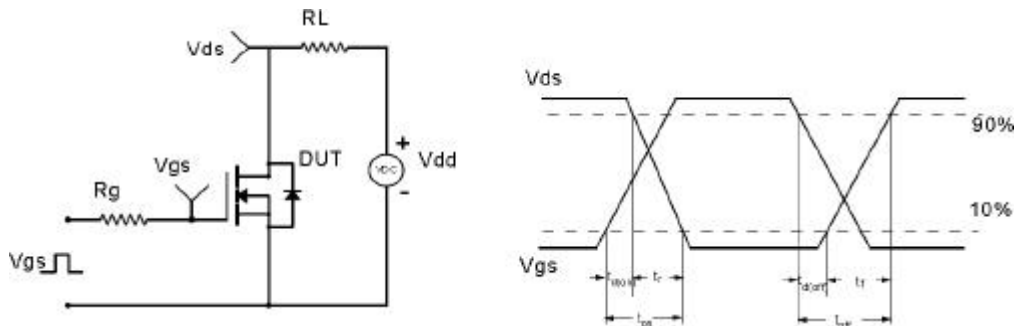


Figure 14. Unclamped Inductive Switching (UIS) Test Circuit & Waveform

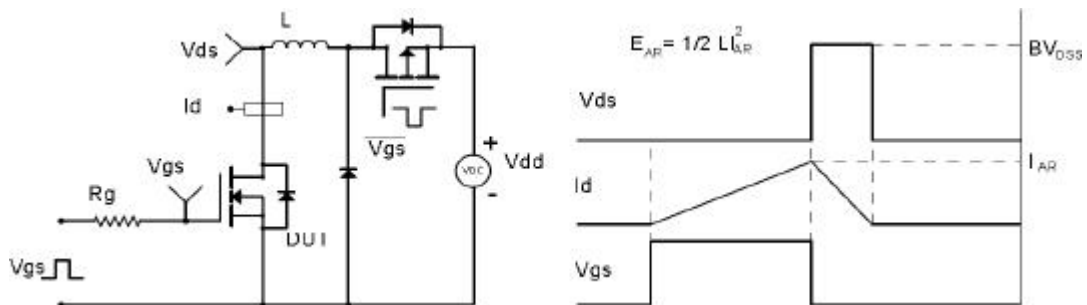
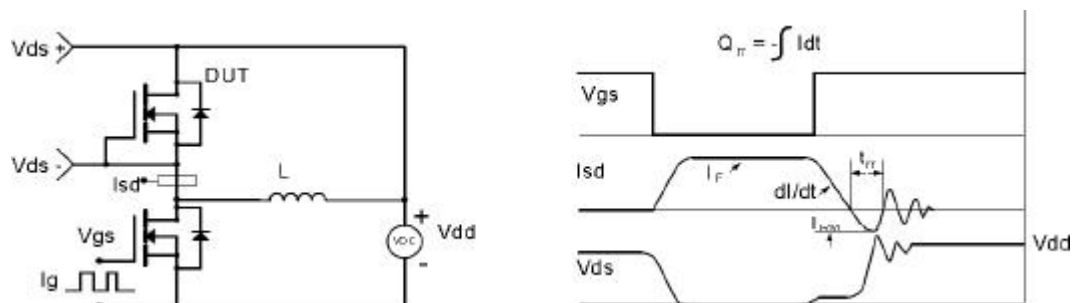
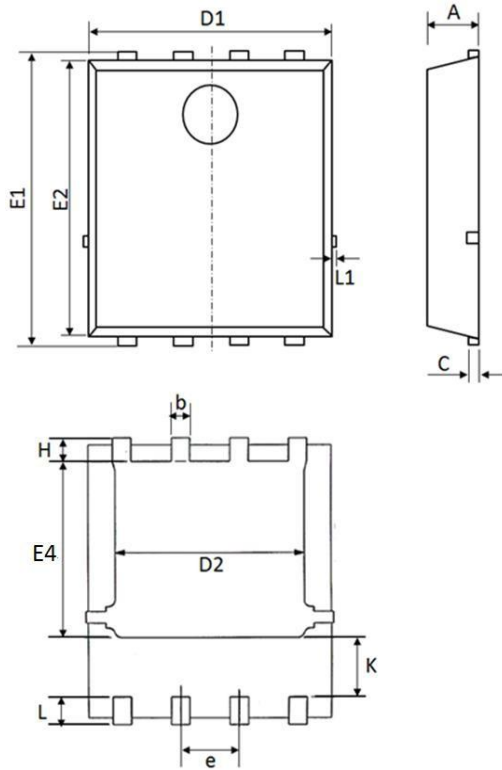


Figure 15. Diode Recovery Circuit & Waveform

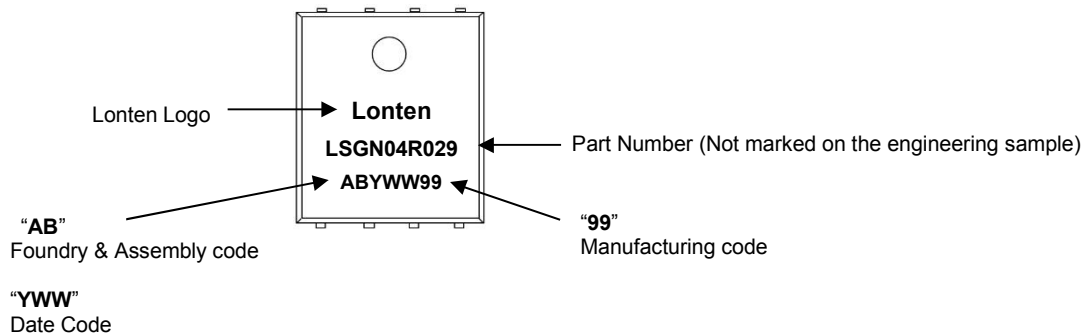


## Mechanical Dimensions for DFN5×6



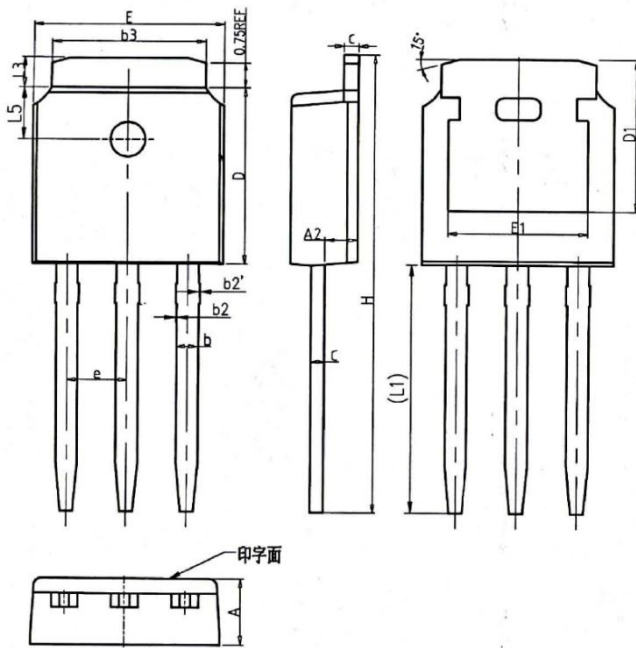
| COMMON DIMENSIONS |             |       |       |           |       |       |
|-------------------|-------------|-------|-------|-----------|-------|-------|
| SYMBOL            | MILLIMETERS |       |       | INCHS     |       |       |
|                   | MIN         | NOM   | MAX   | MIN       | NOM   | MAX   |
| A                 | 1           | 1.1   | 1.2   | 0.039     | 0.043 | 0.047 |
| b                 | 0.3         | 0.4   | 0.5   | 0.012     | 0.016 | 0.020 |
| C                 | 0.154       | 0.254 | 0.354 | 0.006     | 0.010 | 0.014 |
| D1                | 5           | 5.2   | 5.4   | 0.197     | 0.205 | 0.213 |
| D2                | 3.8         | 4.1   | 4.25  | 0.150     | 0.161 | 0.167 |
| E1                | 5.95        | 6.15  | 6.35  | 0.234     | 0.242 | 0.250 |
| E2                | 5.66        | 5.86  | 6.06  | 0.223     | 0.231 | 0.239 |
| E4                | 3.52        | 3.72  | 3.92  | 0.139     | 0.146 | 0.154 |
| e                 | 1.27 BSC    |       |       | 0.050 BSC |       |       |
| H                 | 0.4         | 0.5   | 0.6   | 0.016     | 0.020 | 0.024 |
| L                 | 0.5         | 0.6   | 0.7   | 0.020     | 0.024 | 0.028 |
| L1                | -           | -     | 0.12  | -         | -     | 0.005 |
| K                 | 1.14        | 1.29  | 1.44  | 0.045     | 0.051 | 0.057 |

## DFN5×6 Part Marking Information



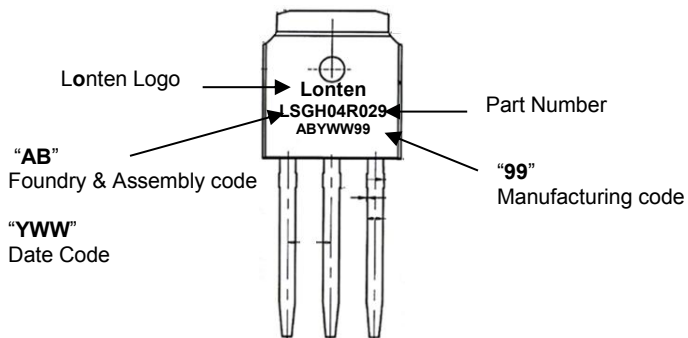
| Calendar Year | Year Code | Calendar Week | Week Code |
|---------------|-----------|---------------|-----------|
| 2018          | G         | Workweek 01   | 01        |
| 2019          | H         | Workweek 02   | 02        |
| 2020          | I         | Workweek 03   | 03        |
| 2021          | J         | Workweek 04   | 04        |
| 2022          | K         | Workweek 05   | 05        |
| 2023          | L         | Workweek 06   | 06        |
| 2024          | M         | .....         | .....     |

## Mechanical Dimensions for TO-251



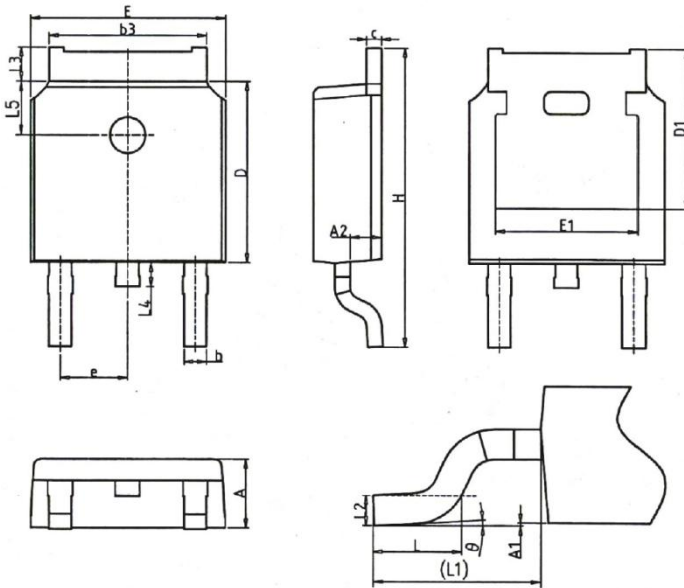
| COMMON DIMENSIONS |          |       |       |          |       |       |
|-------------------|----------|-------|-------|----------|-------|-------|
| SYMBOL            | MM       |       |       | INCH     |       |       |
|                   | MIN      | NOM   | MAX   | MIN      | NOM   | MAX   |
| A                 | 2.20     | 2.30  | 2.38  | 0.087    | 0.091 | 0.094 |
| A2                | 0.97     | 1.07  | 1.17  | 0.038    | 0.042 | 0.046 |
| b                 | 0.68     | 0.78  | 0.90  | 0.027    | 0.031 | 0.035 |
| b2                | 0.00     | 0.04  | 0.10  | 0.000    | 0.002 | 0.004 |
| b2'               | 0.00     | 0.04  | 0.10  | 0.000    | 0.002 | 0.004 |
| b3                | 5.20     | 5.33  | 5.46  | 0.205    | 0.210 | 0.215 |
| c                 | 0.43     | 0.53  | 0.61  | 0.017    | 0.021 | 0.024 |
| D                 | 5.98     | 6.10  | 6.22  | 0.235    | 0.240 | 0.245 |
| D1                | 5.30REF  |       |       | 0.209REF |       |       |
| E                 | 6.40     | 6.60  | 6.73  | 0.252    | 0.260 | 0.265 |
| E1                | 4.63     | -     | -     | 0.182    | -     | -     |
| e                 | 2.286BSC |       |       | 0.090BSC |       |       |
| H                 | 16.22    | 16.52 | 16.82 | 0.639    | 0.650 | 0.662 |
| L1                | 9.15     | 9.40  | 9.65  | 0.360    | 0.370 | 0.380 |
| L3                | 0.88     | 1.02  | 1.28  | 0.035    | 0.040 | 0.050 |
| L5                | 1.65     | 1.80  | 1.95  | 0.065    | 0.071 | 0.077 |

## TO-251 Part Marking Information



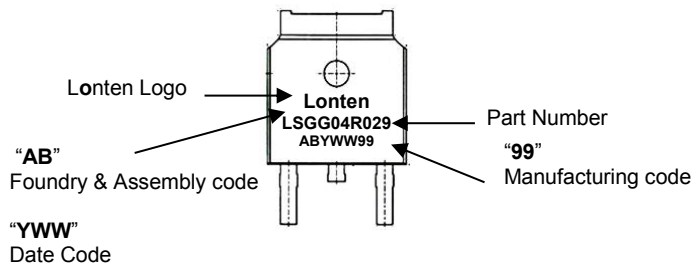
| Calendar Year | Year Code | Calendar Week | Week Code |
|---------------|-----------|---------------|-----------|
| 2018          | G         | Workweek 01   | 01        |
| 2019          | H         | Workweek 02   | 02        |
| 2020          | I         | Workweek 03   | 03        |
| 2021          | J         | Workweek 04   | 04        |
| 2022          | K         | Workweek 05   | 05        |
| 2023          | L         | Workweek 06   | 06        |
| 2024          | M         | .....         | .....     |

## Mechanical Dimensions for TO-252



| SYMBOL | COMMON DIMENSIONS |       |       |          |       |       |
|--------|-------------------|-------|-------|----------|-------|-------|
|        | MM                |       |       | INCH     |       |       |
|        | MIN               | NOM   | MAX   | MIN      | NOM   | MAX   |
| A      | 2.20              | 2.30  | 2.38  | 0.087    | 0.091 | 0.094 |
| A1     | 0.00              | -     | 0.20  | 0.000    | -     | 0.008 |
| A2     | 0.97              | 1.07  | 1.17  | 0.038    | 0.042 | 0.046 |
| b      | 0.68              | 0.78  | 0.90  | 0.027    | 0.031 | 0.035 |
| b3     | 5.20              | 5.33  | 5.46  | 0.205    | 0.210 | 0.215 |
| c      | 0.43              | 0.53  | 0.61  | 0.017    | 0.021 | 0.024 |
| D      | 5.98              | 6.10  | 6.22  | 0.235    | 0.240 | 0.245 |
| D1     | 5.30REF           |       |       | 0.209REF |       |       |
| E      | 6.40              | 6.60  | 6.73  | 0.252    | 0.260 | 0.265 |
| E1     | 4.63              | -     | -     | 0.182    | -     | -     |
| e      | 2.286BSC          |       |       | 0.090BSC |       |       |
| H      | 9.40              | 10.10 | 10.50 | 0.370    | 0.398 | 0.413 |
| L      | 1.38              | 1.50  | 1.75  | 0.054    | 0.059 | 0.069 |
| L1     | 2.90REF           |       |       | 0.114REF |       |       |
| L2     | 0.51BSC           |       |       | 0.020BSC |       |       |
| L3     | 0.88              | -     | 1.28  | 0.035    | -     | 0.050 |
| L4     | 0.50              | -     | 1.00  | 0.020    | -     | 0.039 |
| L5     | 1.65              | 1.80  | 1.95  | 0.065    | 0.071 | 0.077 |
| θ      | 0°                | -     | 8°    | 0°       | -     | 8°    |

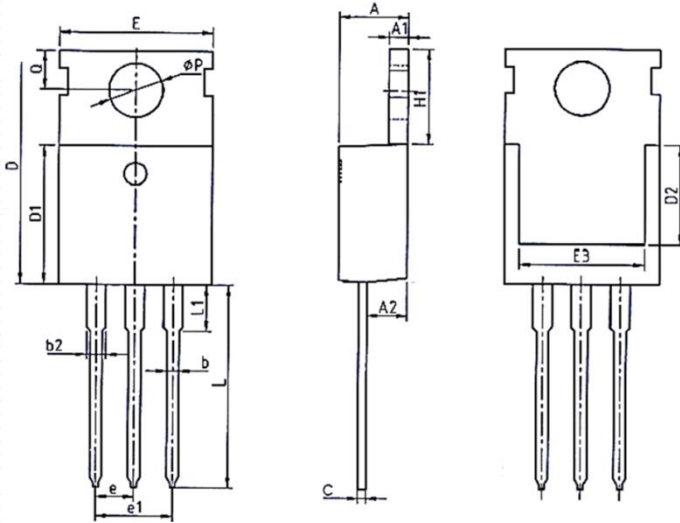
## TO-252 Part Marking Information



| Calendar Year | Year Code | Calendar Week | Week Code |
|---------------|-----------|---------------|-----------|
| 2018          | G         | Workweek 01   | 01        |
| 2019          | H         | Workweek 02   | 02        |
| 2020          | I         | Workweek 03   | 03        |
| 2021          | J         | Workweek 04   | 04        |
| 2022          | K         | Workweek 05   | 05        |
| 2023          | L         | Workweek 06   | 06        |
| 2024          | M         | .....         | .....     |

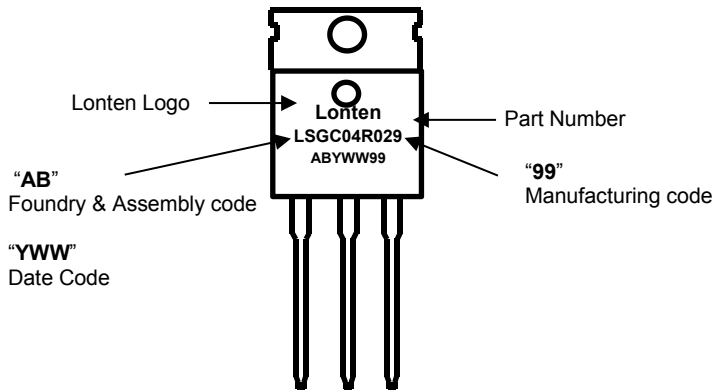


**TO-220 PACKAGE INFORMATION**



| SYMBOL | COMMON DIMENSIONS |       |       |        |       |       |
|--------|-------------------|-------|-------|--------|-------|-------|
|        | MM                |       |       | INCH   |       |       |
|        | MIN               | NOM   | MAX   | MIN    | NOM   | MAX   |
| A      | 4.37              | 4.57  | 4.70  | 0.172  | 0.180 | 0.185 |
| A1     | 1.25              | 1.30  | 1.40  | 0.049  | 0.051 | 0.055 |
| A2     | 2.20              | 2.40  | 2.60  | 0.087  | 0.094 | 0.102 |
| b      | 0.70              | 0.80  | 0.95  | 0.028  | 0.031 | 0.037 |
| b2     | 1.17              | 1.27  | 1.47  | 0.046  | 0.050 | 0.058 |
| c      | 0.45              | 0.50  | 0.60  | 0.018  | 0.020 | 0.024 |
| D      | 15.10             | 15.60 | 16.10 | 0.594  | 0.614 | 0.634 |
| D1     | 8.80              | 9.10  | 9.40  | 0.346  | 0.358 | 0.370 |
| D2     | 5.50              | -     | -     | 0.217  | -     | -     |
| E      | 9.70              | 10.00 | 10.30 | 0.382  | 0.394 | 0.406 |
| E3     | 7.00              | -     | -     | 0.276  | -     | -     |
| e      | 2.54BCS           |       |       | 0.1BSC |       |       |
| e1     | 5.08BCS           |       |       | 0.2REF |       |       |
| H1     | 6.25              | 6.50  | 6.85  | 0.246  | 0.256 | 0.270 |
| L      | 12.75             | 13.50 | 13.80 | 0.502  | 0.531 | 0.543 |
| L1     | -                 | 3.10  | 3.40  | -      | 0.122 | 0.134 |
| ØP     | 3.40              | 3.60  | 3.80  | 0.134  | 0.142 | 0.150 |
| Q      | 2.60              | 2.80  | 3.00  | 0.102  | 0.110 | 0.118 |

**TO-220 Part Marking Information**



| Calendar Year | Year Code | Calendar Week | Week Code |
|---------------|-----------|---------------|-----------|
| 2018          | G         | Workweek 01   | 01        |
| 2019          | H         | Workweek 02   | 02        |
| 2020          | I         | Workweek 03   | 03        |
| 2021          | J         | Workweek 04   | 04        |
| 2022          | K         | Workweek 05   | 05        |
| 2023          | L         | Workweek 06   | 06        |
| 2024          | M         | .....         | .....     |

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